

AfrOBIS: a marine biogeographic information system for sub-Saharan Africa

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AfrOBIS is one of 11 global nodes of the Ocean Biogeographic Information System (OBIS), a freely accessible network of databases collating marine data in support of the Census of Marine Life. Versatile graphic products, provided by OBIS, can be used to display the data. To date, AfrOBIS has loaded about 3.2 million records of more than 23 000 species located mainly in the seas around southern Africa. This forms part of the 13.2 million records of more than 80 000 species currently stored in OBIS. Scouting for South African data has been successful, whereas locating records in other African countries has been much less so.

Introduction

The past, present and future state of marine life in terms of diversity, distribution and abundance is a prime concern of the Census of Marine Life (CoML; www.coml.org).¹ A global programme established in 2000, CoML identified 6 realms in the marine environment—ranging from human impact to the abyssal plains, the ice oceans and even the world of microbes—with each realm investigated via one or more projects. There are 17 projects in all, mostly defined in terms of a specific geographical feature, habitat or

biological community: for example, the Natural Geography of Shore Areas, the Census of Diversity of Abyssal Marine Life, the Census of Antarctic Marine Life, the Census of Seamounts, and the Census of Marine Plankton.

To handle data emanating from the census programmes, but mainly to establish an inventory of past and present marine species, OBIS (the Ocean Biogeographic Information System; www.iobis.com) is one of the CoML projects and aims to become the primary, authoritative, global source of marine biogeographic data.^{1,2} OBIS takes the form of a central database (iOBIS) at Rutgers University in New Jersey, and 11 regional OBIS nodes (RONs) globally distributed. The introduction of the RONs in 2005/6 provided fresh impetus to data gathering: OBIS contained 5 million records in 2004, 6 million in 2005, 10 million in September 2006, and had logged about 13 million observations of some 80 000 species by December 2006.

The responsibility to set up and manage the Sub-Saharan African OBIS Node (AfrOBIS; afrobis.csir.co.za) was given to SADCO (Southern African Data Centre for Oceanography based in Stellenbosch; sadco.csir.co.za) because of its track record in dealing with physical oceanographic data over a similar geographical area (see Fig. A in supplementary material online). AfrOBIS officially started on 1 July 2005 with launching the system (software, portal, data structure, load/extraction routines), followed by data scouting and loading.

This article aims to introduce the way AfrOBIS works, the extent of the data stored so far, and to summarize some of the products that can be generated from the OBIS records.

Data management

The establishment of a centralized database (iOBIS) linked via the Web to regional databases all over the world allows virtually immediate uploading of data into a regional node, through a process known as 'crawling' (or 'harvesting'), and integration into the global data set. This provides users with seamless access to observations from other observers and programmes, enabling a more holistic understanding of how life in the sea is distributed.

Spatial-visualization tools are freely available online to all users (see examples used to illustrate this article). A request for data placed by a user of AfrOBIS is uploaded to iOBIS, whence the records are extracted and the products generated and downloaded directly to the enquirer. The 'data' can range from a specific data set from a particular provider, to more generic information (such as all observations on tuna), integrated globally from all sources and extracted in terms of time or geography dictated by the user.

AfrOBIS quality control

Data scouted by AfrOBIS vary from fully computerized sets to hand-written entries in registers and on cards (which need to be digitized). Many of the older, still valuable records, with observations going back to the 19th century, fall in the latter category. Because AfrOBIS presently focuses on 'voucher' data (digitized information on actual specimens kept by the original source), it is possible that taxonomic identifications have not been peer reviewed or the nomenclature may be outdated. As with most databases, AfrOBIS relies on the diligence of the various information gatherers to ensure that its quality is as good as is practically possible.

After uploading data, iOBIS cross-references the taxonomy cited with the Catalogue of Life.³ If any differences are found, the new material is indexed in such a way that data searches, using the Catalogue of Life nomenclature, can still locate the entries.

A key element of the data is its geolocation, so that records without valid latitude and longitude are not accepted. The position claimed is also checked for possible overland location, using an independent digital bathymetric data set as well as visual inspection.

Data scouting and loading

The volume of data loaded into AfrOBIS since 1 July 2005 amounts to about 3.2 million records of some 23 000 species. Each

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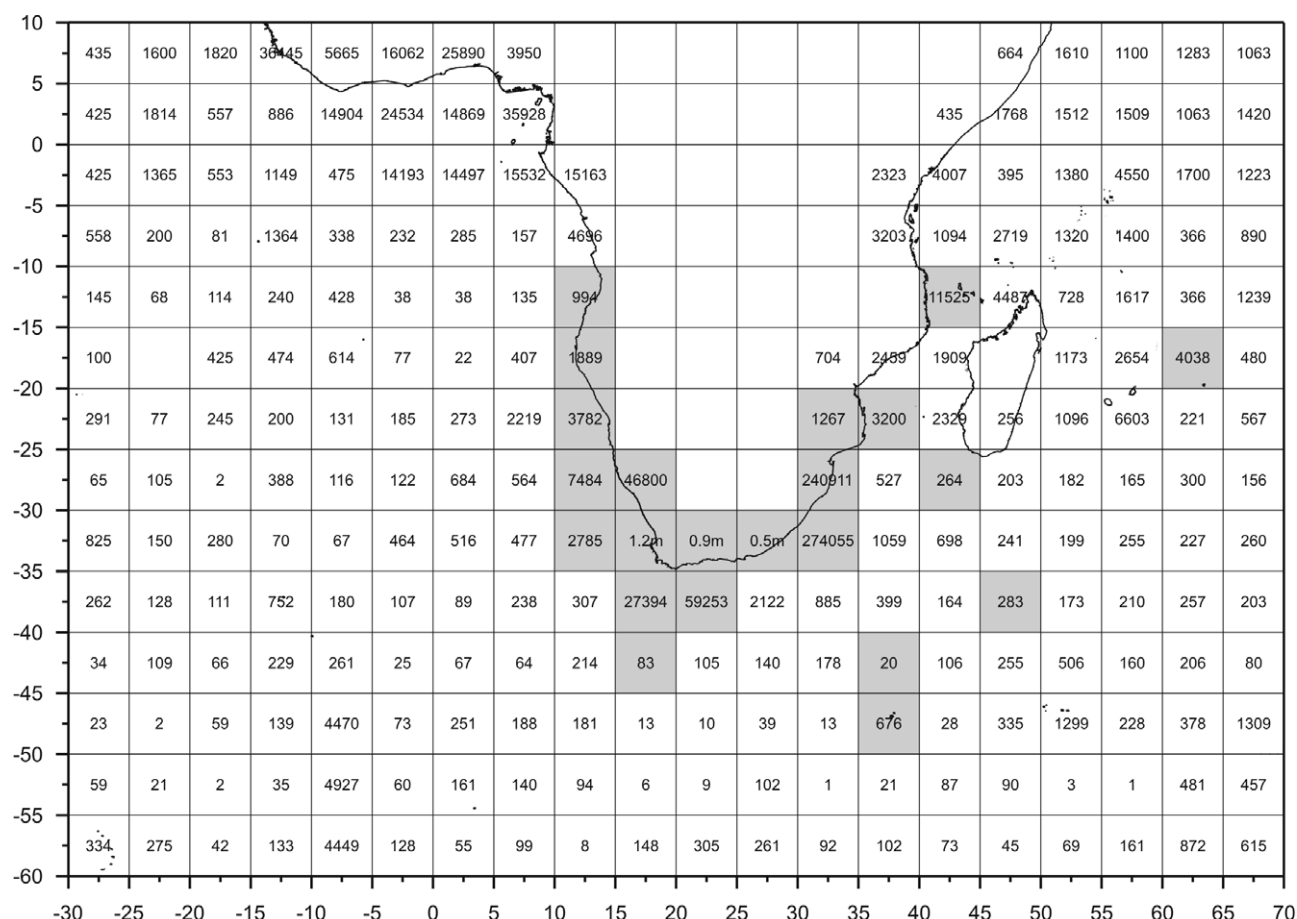


Fig. 1. Distribution of all data records in OBIS around southern Africa in December 2006, in the same area as Fig. A (in the supplementary material online). Blocks in which AfrOBIS contributed more than 50% of the total OBIS holdings are shaded.

record comprises at least a scientific name, date, latitude and longitude. Optional additional information include kingdom, genus, species, depth, observed count in sample, locality, ocean and life stage, if these are also supplied by the original source.

The spatial coverage of all OBIS data around southern Africa on 31 December 2006 is indicated in Fig. 1. Because OBIS is growing, its records are continuously evolving, so only some spatial trends are mentioned here. Observations in the open ocean are typically less than 1000 per 5° square. Smaller mid-ocean peaks in information are associated with the West Indian Ocean islands, with the northern Mozambique Channel, and with the area around 55°S, 10°W. Closer to the coast, the numbers are higher: there are blocks containing more than 20 000 records in the Gulf of Guinea region, off Namibia and South Africa. The most numerous observations contributed by AfrOBIS (comprising more than 50% of the total number of observations available in OBIS) come from the waters off southern Angola, Namibia, South Africa, west of Mauritius and off the Prince Edward Islands. At a species level the geographic impact of

AfrOBIS data can be even more significant in relation to global distributions of marine organisms, as can be seen from the seaweed data collected by the Bolus Herbarium, Cape Town (see Fig. B in supplementary material online).

Data scouting was particularly successful in South Africa, with 99.8% of AfrOBIS records originating here. This success can be ascribed to the willingness of participating organizations to share their data, particularly the Marine and Coastal Management Branch of the South African Department of Environmental Affairs and Tourism. Although the records obtained from direct support for digitizing thus far represent only 2.6% of the AfrOBIS data holdings (the rest was already digitized), we surmise that the more 'exotic' organisms and greater species distribution were captured in these records.

In contrast, the scouting of data from countries outside South Africa was less successful. Scientists in 20 countries were contacted for their observations—we have heard from half these nations, but only three have actually submitted complete data sets thus far.

Examples of OBIS products

Although OBIS is still in its relative infancy, the available online products are powerful and extensive. They include:

- An interactive global chart (www.iobis.org) that can be clicked to obtain insight into an observed species list in selected squares (from 10° squares down to some as small as 0.5°), along with the number of global observations of those species.
- Pre-generated global plots of selected species and genera that can be displayed and downloaded ([www.iobis.org/Browse by taxonomic groups](http://www.iobis.org/Browse%20by%20taxonomic%20groups)). Sub-sections (over smaller areas) can easily be selected.
- Moreover, records can be extracted, and plots generated, according to any combination of: a *geographical window*, specified in terms of latitude and longitude, EEZ (exclusive economic zone), or via a click-and-drag process; an individual data set, or any combination of these in iOBIS (see plots of some AfrOBIS data sets in Fig. 2 and Figs C and D in supplementary material online); *species*, either through common names or by scientific name; and *time*, in respect of years, months, or even days.

Data sets can be plotted spatially as individual observations or aggregated over

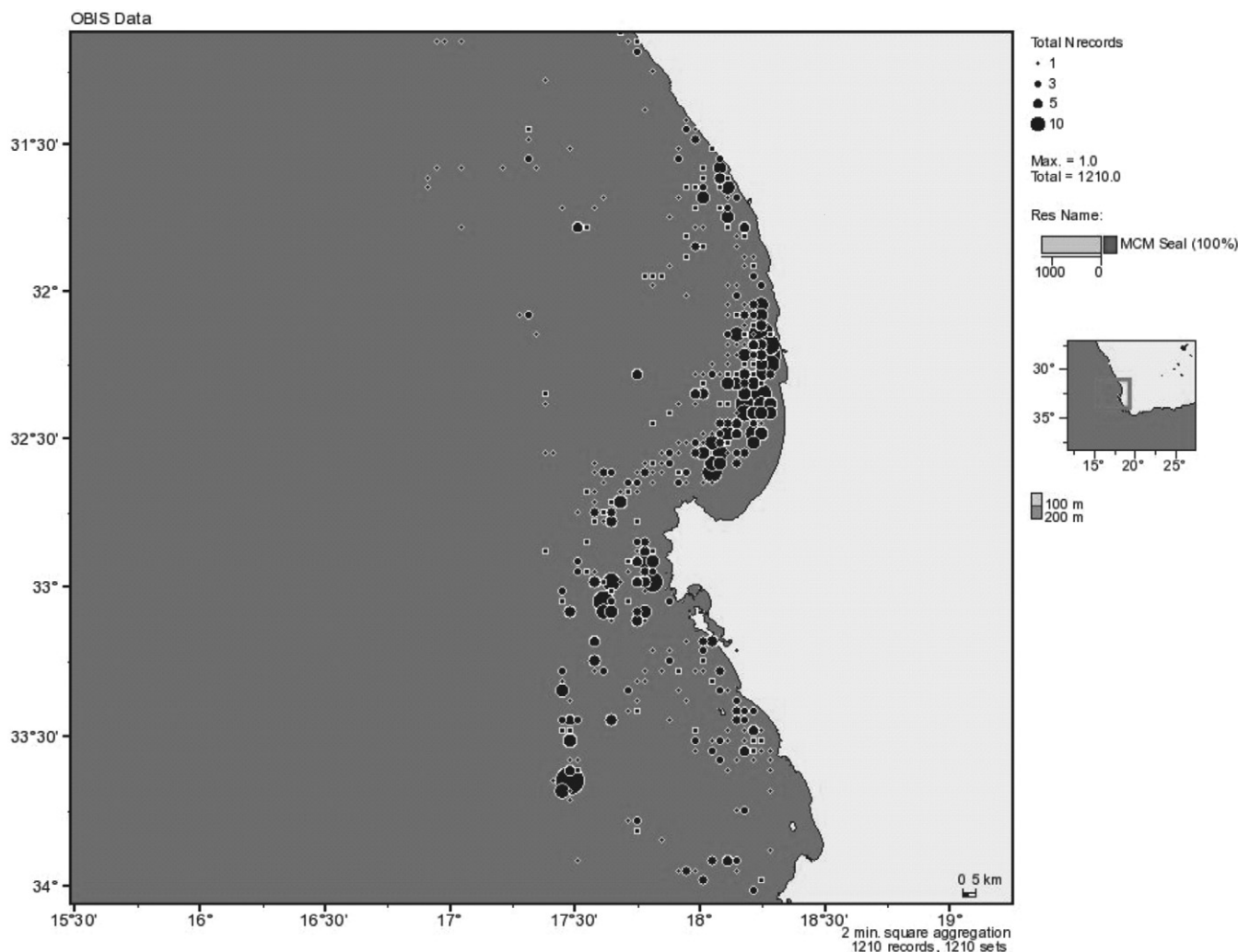


Fig. 2. Density plot of a section (1210 observations) of the seal data supplied by Marine and Coastal Management, Cape Town. Plot provided by OBIS.

selectable rectangles to show the density of records. Spatial distributions of species, subdivided in terms of, for example, time or data provider, can also be generated. Plots and raw data (actual records) can be downloaded on request.

Conclusion

The establishment of AfrOBIS augurs well for the pan-African management of marine biogeographic information. The products obtainable online from iOBIS

are easy to generate. Future developments will focus primarily on follow-up scouting throughout Africa and, later on, aspects of data beneficiation, such as integrating AfrOBIS and SADCO data.

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(East London) for the preparation of valuable data sets.

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Supplementary material to:

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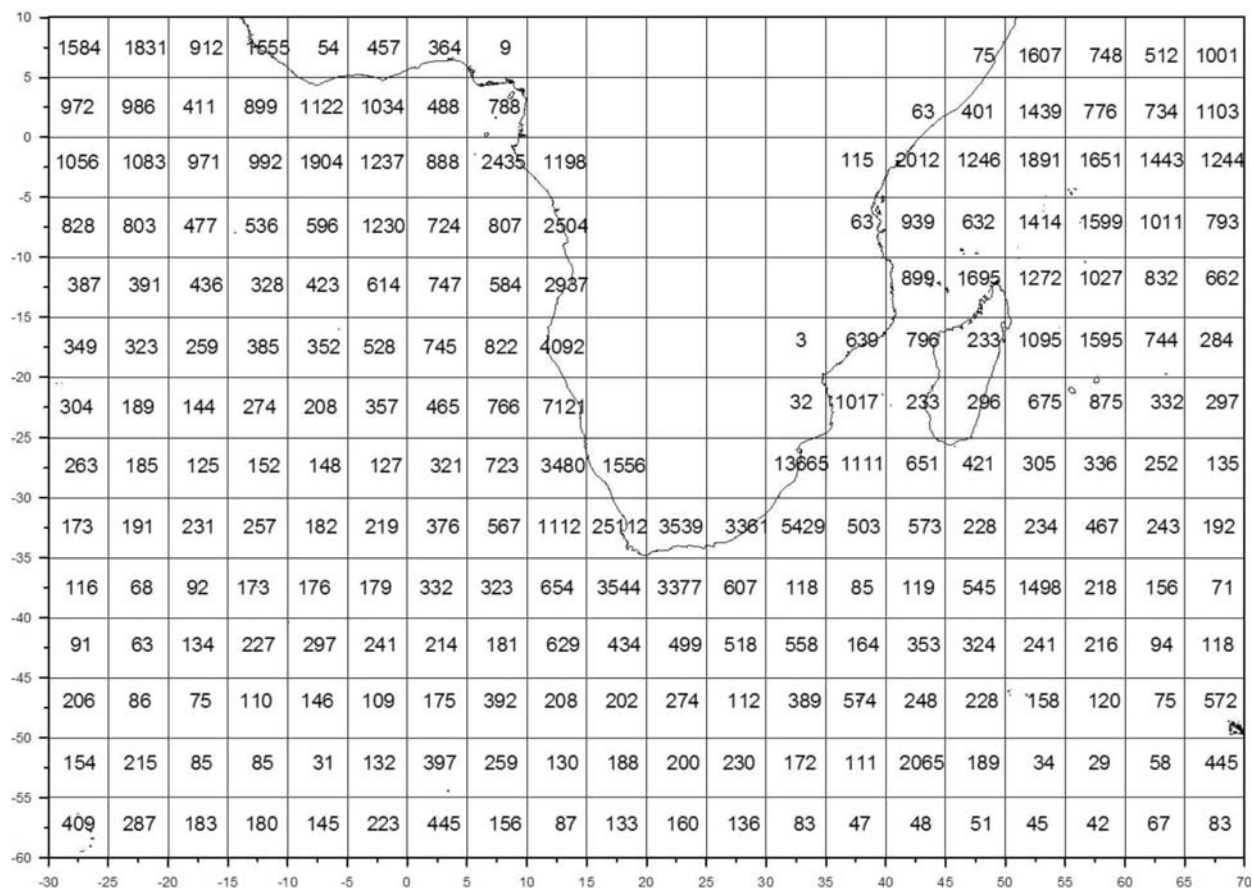


Fig. A. Distribution of the approximately 200 000 hydrographic stations in SADC's target area (which extends farther south to Antarctica).

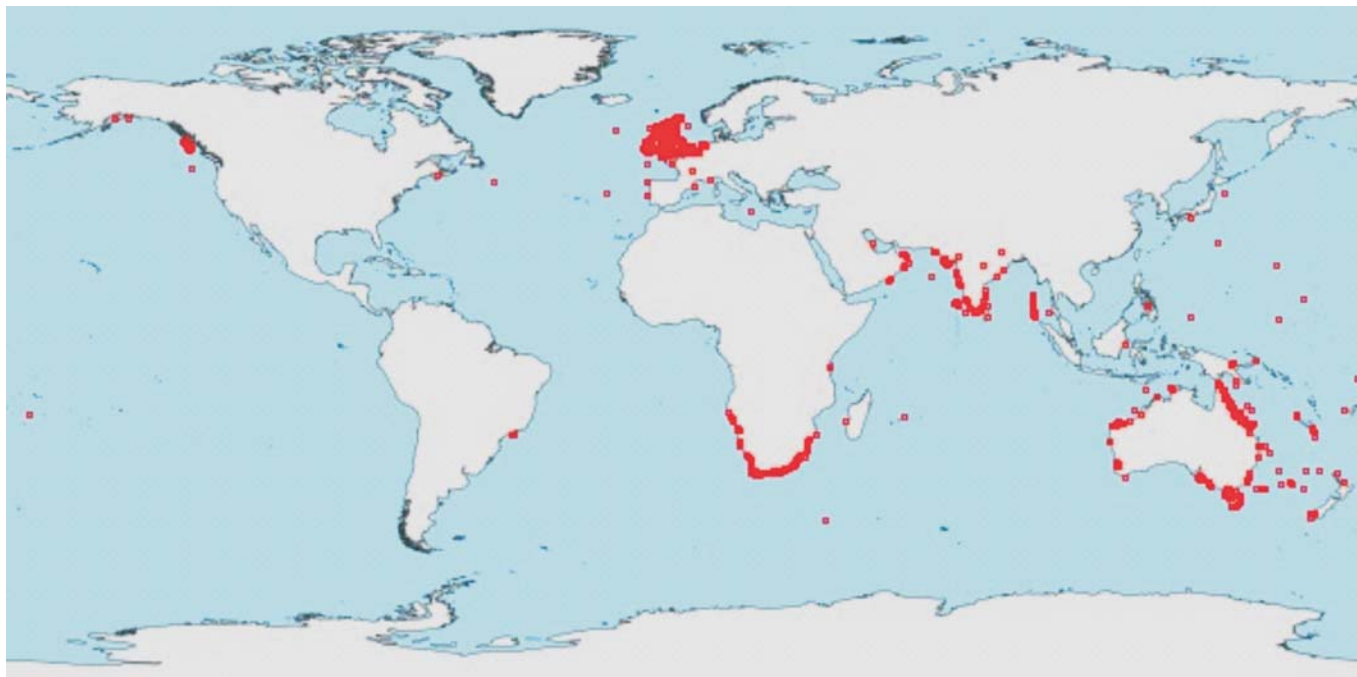


Fig. B. Global plot of seaweed data in OBIS (derived from many data sets). The observations off South Africa and Namibia originate from the Bolus Herbarium, University of Cape Town. Plot provided by OBIS.

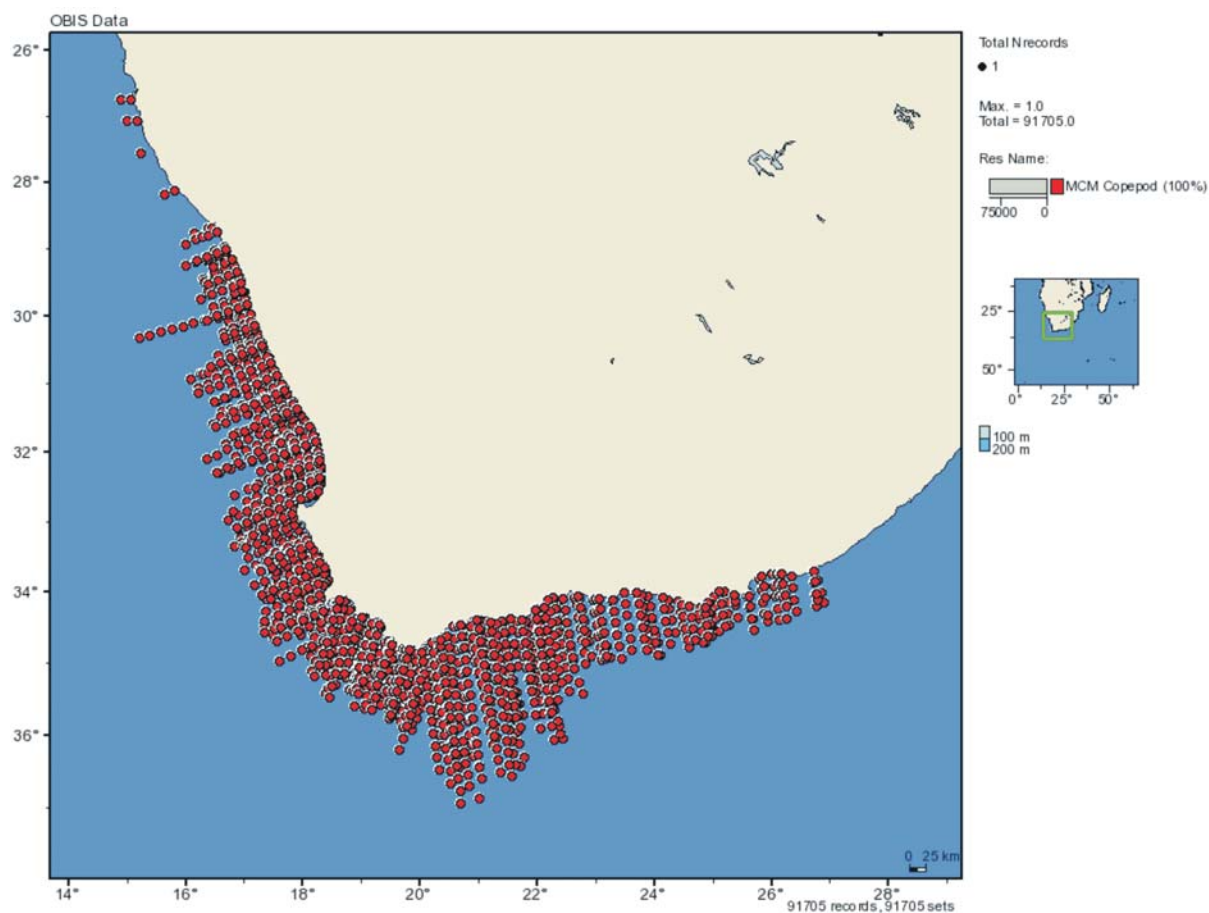


Fig. C. Plot of all copepod observations (91 705 records) provided by Marine and Coastal Management, Cape Town. Plot provided by OBIS.

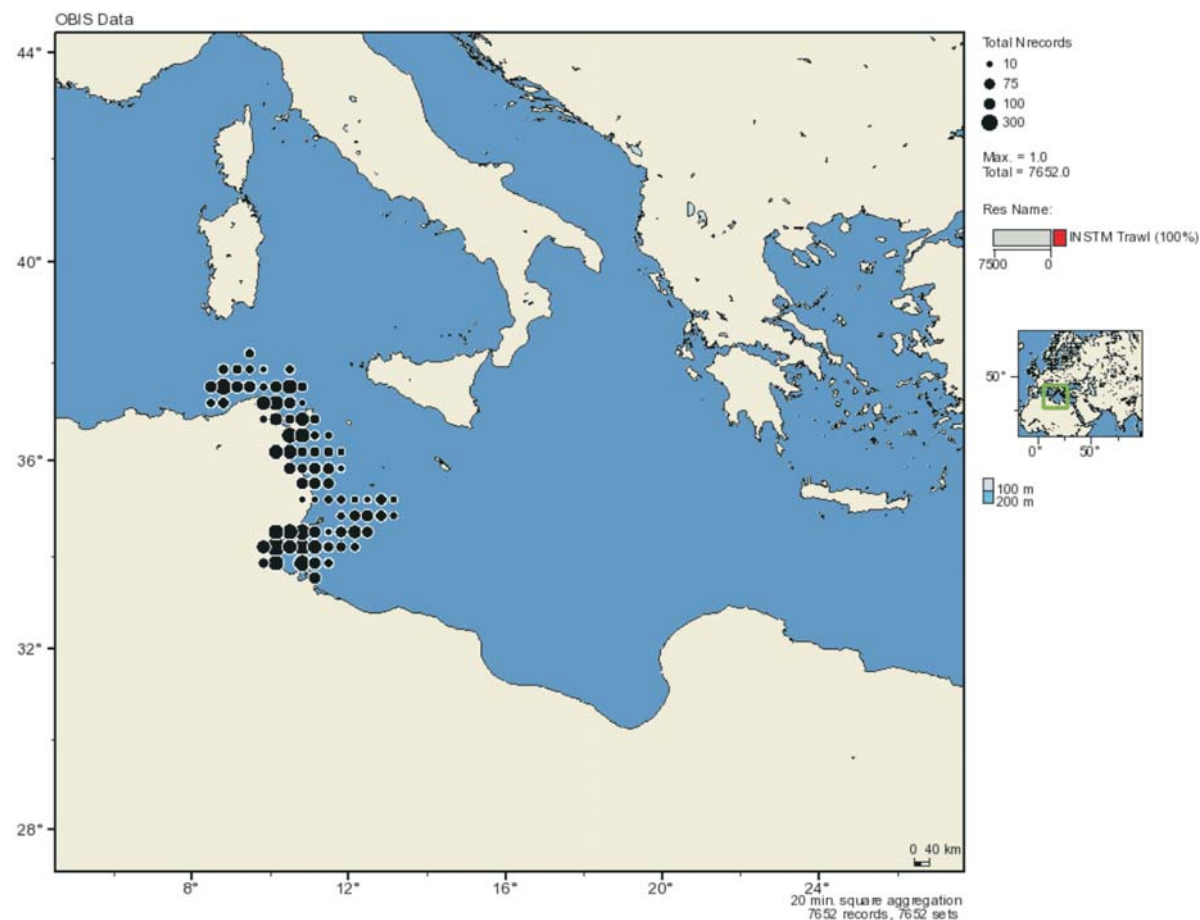


Fig. D. Density plot of 7652 trawl data records supplied by the National Institute of Marine Sciences and Technologies, Tunisia. Plot provided by OBIS.